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LIGHT-BURNING CLAY RESOURCES IN LA SALLE COUNTY, ILLINOIS

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ABSTRACT

For this study of the nature and possible uses for the light-burning clay deposits of LaSalle County, Illinois, about 50 samples of the underclay below the No. 2 Coal were collected and tested.

Laboratory tests were run to determine the drying and firing shrinkage, water of plasticity, fired color, refractoriness, and bonding properties of the clay. The thickness of the clay, its overburden, and types of associated sediments were recorded from field observations and, at some places, from water well drillers' logs.

The most favorable areas for prospecting for light-burning clay are found along the top of the river bluffs on the south side of the Illinois River between the towns of LaSalle and Ottawa, and in the valley flats east of Ottawa along the north side of the river. Most of the shallow light-burning clay deposits observed in outcrop have been exhausted or are now being quarried, but exploratory drilling may locate other deposits at depths shallow enough to be worked commercially.

INTRODUCTION

LaSalle County in north-central Illinois, about 80 miles southwest of Chicago, is divided into a north and south section by the westward flowing Illinois River. Near Streator, LaSalle, and Ottawa, local clay resources provide a source of income for many people. Many of the older clay pits have been worked out and a number of new pits have been dug. This report on the clay resources of the county may serve as a guide for those interested in locating and exploiting new clay deposits.

The major part of LaSalle County is covered by Pleistocene glacial deposits (Cady, 1919; Willman and Payne, 1942), but outcrops of the older rocks are found generally along the Illinois, Vermilion, and Fox Rivers. Some of these outcrops include exposures of clay below the No. 2 Coal, Pennsylvanian in age, which rests on the older Ordovician rocks (fig. 1). The normal sequence of rocks encountered in outcrop and drill holes throughout this area is shown in a generalized form in figure 2.

In LaSalle County the bedrock strata have been folded into an anticline that trends north-northwest to south-southeast across the county and is known as the LaSalle Anticline (fig. 1). The beds on its east side slope gently toward the east but those on the west side dip steeply westward.

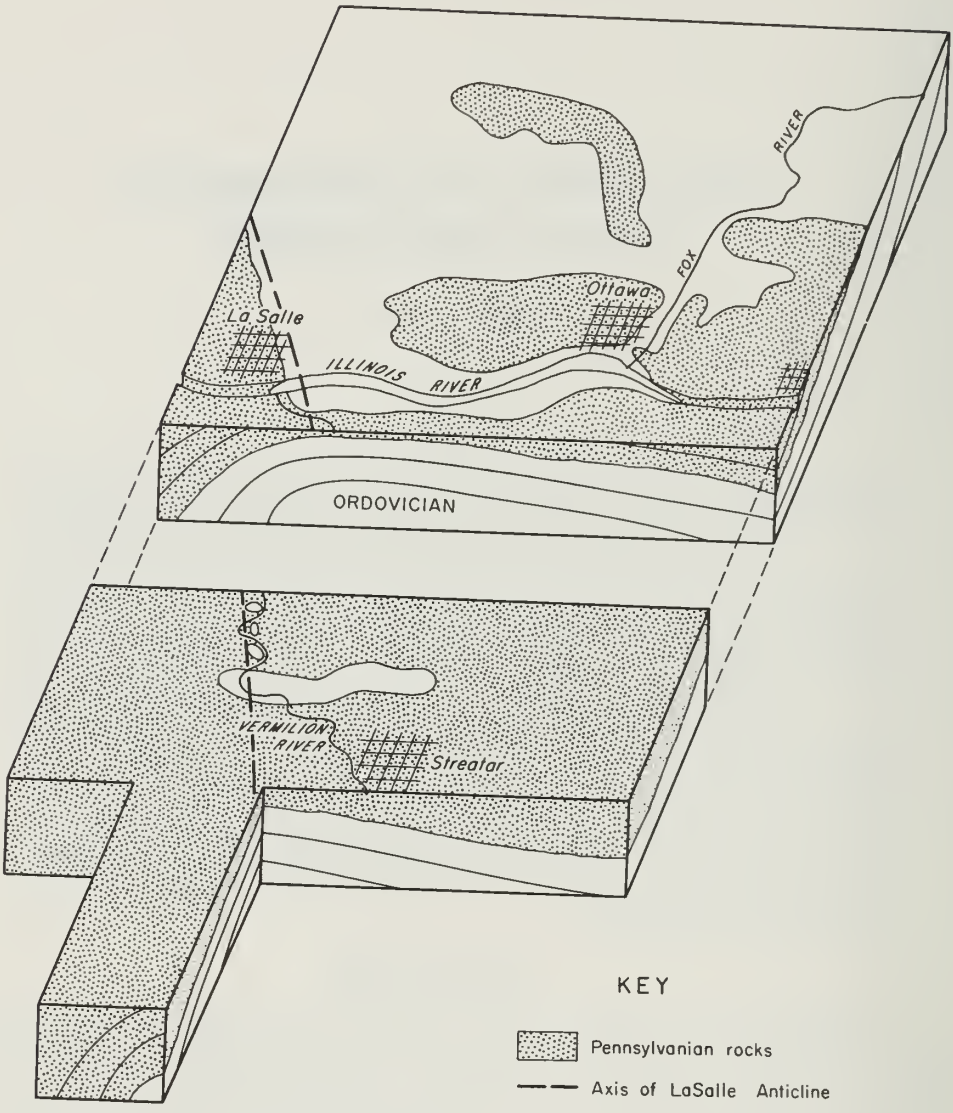

Fig. 1. - Generalized block diagram of the bedrock in LaSalle County.

The clays underlying the No. 2 Coal have been used widely in the brick and structural clay products industries in LaSalle County. Various deposits have been found to be satisfactory for use in face brick, stoneware, terra cotta, sewer pipe, and refractory and bonding clays. Probably the majority of the county is underlain by similar deposits, but the only exposures are along the Illinois River between Ottawa and LaSalle, and at a few other localities near the mouths of the Vermilion and Fox Rivers (fig. 3).

A more complete account of the geology of this region is given in reports by Cady (1919) and Willman and Payne (1942). Additional data on ceramic tests of the light-burning clays of LaSalle County are given in reports by Willman and Payne (1942) and Parmelee and Schroyer (1921).

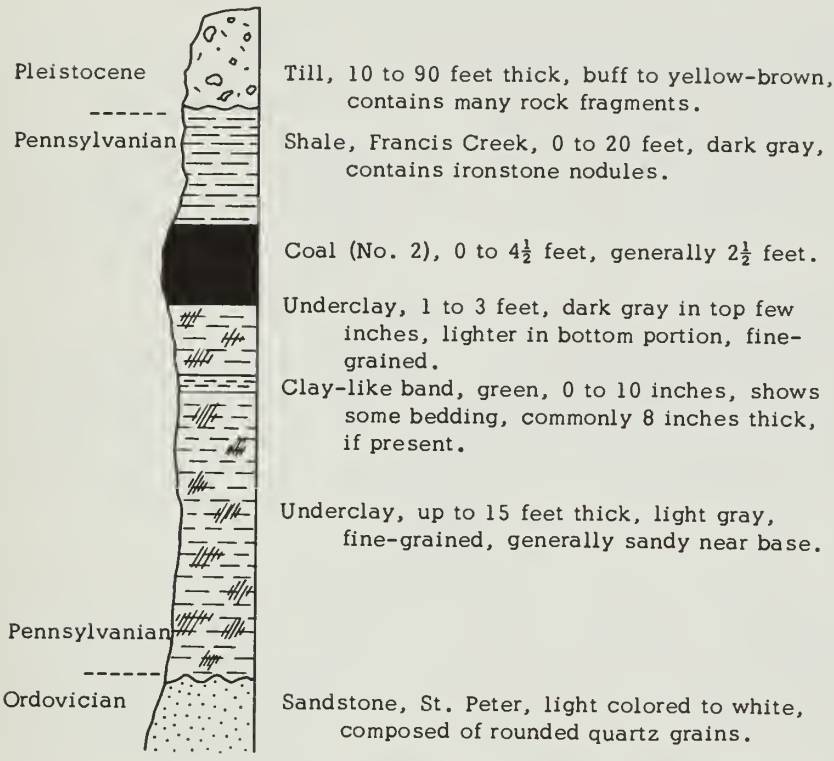

Fig. 2. - Generalized geologic column.

REPORTS OF TESTS

This report includes locations of existing clay deposits, their thickness, overburden, type of underlying sediment, and the results of tests on the physical properties of the clay. The test results include the drying and firing shrinkage of the clay, water of plasticity, fired colors, refractoriness, bonding properties, and possible uses.

This type of information should aid in determining the most favorable locations for prospecting for clay of a desirable nature. At a few places a single underclay outcrop was divided into two or three samples from the top of the outcrop to the bottom to facilitate study of any vertical changes in its behavior. The top sample was given the letter "A," the next lower sample "B," and so forth. (Samples 1486, 1492, 1496, and 1499.) All other clay outcrops were sampled as single units.

Extrusion and Firing of Test Bars

Each sample of clay was dried and crushed to approximately $\frac{1}{4}$-inch in diameter or smaller. The sample was then mixed with enough water to develop plasticity and extruded into three individual test bars, each with the dimensions of 1 by 1 by 6 inches. The bars were air dried for at least two days, then measured to determine the percentage of drying shrinkage of the clay. The first brick was fired at 1832°F, the second at 2012°F, and the third at 2200°F. After each firing, the bars were measured to determine the percentage of firing shrinkage.

Fig. 3. - Map of LaSalle County showing locations of outcrops sampled and the area most favorable for exploratory drilling.

The water of plasticity was determined for each sample at the time the test bars were extruded. Water of plasticity is that amount of water that must be added to a clay sample in order to develop plasticity. In general, it can be said that the greater the water of plasticity, the greater the shrinkage during drying and firing of a given clay.

Samples 1504 and 1508 were not fired at 2200° F because at lower temperatures they had indicated they would be unable to withstand higher firing temperatures. Sample 1508 had already started to bloat, and sample 1504 had developed a glassy surface and a deep brick-red color.

Color of Fired Test Bars

Most of the clay samples for this study were taken from outcrops, and it is probable that weathering had altered the burning color of the clay. For a better indication of true burning color, it would be necessary to obtain unweathered samples of the clay from drill holes near the area in question. Our experience in the past has shown that a weathered light-burning clay usually burns darker than unweathered clay from the same deposit.

High-Temperature Properties

By testing the refractoriness of each sample, it was found that ten samples from LaSalle County withstood temperatures of cone 28 and above. Refractories are classified in the following manner (American Society of Testing Materials, 1958):

High heat duty.....PCE (Pyrometric Cone Equivalent) of 31 or 32

Medium heat duty .....PCE of at least 29

The following uses have been suggested for these refractory clays (Coxey, 1950):

High heat duty clays are often used for open hearth checkers in steel plants, linings and checkers in hot-blast stoves, cupola linings, rotary cement and lime kiln linings, shaft lime kiln linings, and high-temperature boiler settings.

Intermediate heat duty clays have been used for cupola linings, lime kilns, heating furnaces, back-up courses of furnace walls, and as linings in ladles in iron and steel foundries.

Although the lower limit in PCE for medium heat duty clays is 29, some of the LaSalle County clays ranged from 28 to 29 and are included in this classification.

Bonding Tests

Because underclays are sometimes used as bonding clay for foundry sands, bonding tests were run on all but the extremely sandy samples. The clays were first ground in a disc grinder. A 2000-gram mixture of 92 percent bonding sand and 8 percent clay was made and mixed dry for two minutes in a sand muller. Water was then added to the mixture in the muller and three minutes of wet mixing followed. The wet mixtures were placed in sealed jars and allowed to set overnight in order to give the water sufficient time to mix thoroughly with the clay. Mixtures were made with varying amounts of water, 30 ml, 35 ml, and 45 ml. For some samples of the stronger bonding clays, additional mixtures with 55 ml of water were made. The tests were run in a manner described in the Foundry Sand Handbook (American Foundrymen's Society, 1952). A few of the samples were too sandy for the bonding test described above. These were tested in their natural state to determine whether they could be used for natural molding sand.

RESULTS OF TESTS

Sample 1485
C NE¼ SW¼ sec. 8, T. 32 N., R. 2 E.

Glacial drift and soil	10'	Thickness of clay	0-17'
Underclay (sample 1485)	0-17'	Extrusion properties	Fair
Sandstone		Water of plasticity	15.0%
		% Linear drying shrinkage	4.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	3.0	4.0
Total linear shrinkage	6.0	7.0	8.0
Fired color	Cream	Cream	Gray

Surface texture of fired test bar: Shows irregular edges. Spotted and pock-marked by pyrite at 2200°F

PCE: <28
Overburden: 10'; sediment above: till; sediment below: sandstone.
Bonding properties: 4.75 (GCS psi); 1.0% (Optimum H_2O).
Possible uses: structural clay products, drain tile, flower pots.

Sample 1486
NW¼ NE¼ SW¼ sec. 8, T. 32 N., R. 2 E.

Glacial drift and soil	20'+	Thickness of clays	7'
Calcareous nodules	2"	Extrusion properties	Good
Underclay (sample 1486-A)	3½'	Water of plasticity	14.0%
Pyrite band	1"	% Linear drying shrinkage	5.5
Underclay (sample 1486-B)	3½'		

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	3.0	4.0	3.0
Total linear shrinkage	8.5	9.5	8.5
Fired color	Cream	Gray-brown	Gray

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 20'; sediment above: till; sediment below: sandstone.
Bonding properties: 6.75 (GCS psi); 1.9% (Optimum H_2O).
Possible uses: Structural clay products, stoneware, pottery, drain tile.
Comment: Sample 1486 is a composite of samples 1486-A and 1486-B.

Sample 1486-A

Thickness of clay	3½'
Extrusion properties	Good
Water of plasticity	15%
% Linear drying shrinkage	5.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.0	5.5
Total linear shrinkage	7.5	9.0	10.5
Fired color	Cream	Cream	Gray

Surface texture of fired test bar: Blistery surface at 2200°F

PCE: <28
Overburden: 20'
Bonding properties: 6.90 (GCS psi); 1.8% (Optimum H_2O).
Possible uses: Structural clay products, stoneware, pottery, drain tile, flower pots.
Comment: Sample from top 3½' of underclay.

Sample 1486-B

Thickness of clay	3½'
Extrusion properties	Fair
Water of plasticity	14.0%
% Linear drying shrinkage	5.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	5.0	0.5
Total linear shrinkage	7.5	10.0	5.5
Fired color	Cream	Gray-brown	Gray

Surface texture of fired test bar: Shows irregular edges. Spotted and pock-marked by pyrite at 1832°, 2012°, and 2200°F

PCE: <28
Overburden: 23'9"
Bonding properties: 6.60 (GCS psi); 2.0% (Optimum H_2O).
Possible uses: Structural clay products, drain tile, flower pots.
Comment: Sample from bottom 3½' of underclay.

Sample 1487
NW¼ NE¼ SW¼ sec. 8, T. 32 N., R. 2 E.

Till	20'	Thickness of clay	Small pocket
Underclay, pocket (sample 1487)	?	Extrusion properties	Fair
Sandstone		Water of plasticity	13.0%
		% Linear drying shrinkage	4.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	1.0	3.5	2.5
Total linear shrinkage	5.0	7.5	6.5
Fired color	Cream	Cream	Gray

Surface texture of fired test bar: Shows irregular edges

PCE: <28
Overburden: 20'; sediment above: till; sediment below: sandstone.
Bonding properties: 3.90 (GCS psi); 1.4% (Optimum H_2O).
Possible uses: Structural clay products, drain tile, flower pots.
Comment: Sample from small pocket of clay.

Sample 1488
NW¼ SW¼ NE¼ sec. 5, T. 32 N., R. 2 E.

Glacial drift and soil	40'-60'	Thickness of clay	17'
No. 2 Coal	3'	Extrusion properties	Good
Underclay (sample 1488)	17'	Water of plasticity	11.0%
Dolomite		% Linear drying shrinkage	4.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	4.5	6.5
Total linear shrinkage	6.0	8.5	10.5
Fired color	Pink	Salmon	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 40'-60'; sediment above: coal, 3'; sediment below: dolomite.
Bonding properties: 7.70 (GCS psi); 1.8% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.

Sample 1490
SW¼ NW¼ NW¼ sec. 32, T. 33 N., R. 2 E.

Glacial drift, soil	10'-20'	Thickness of clay	3'-5'
No. 2 Coal	3½'-4½'	Extrusion properties	Good
Underclay, contains much pyrite (sample 1490)	3'-5'	Water of plasticity	15.0%
		% Linear drying shrinkage	5.0
Sandstone			

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	4.5	4.5	5.0
Total linear shrinkage	9.5	9.0	10.0
Fired color	Salmon	Tan	Gray-brown

Surface texture of fired test bar: Spotted and pock-marked by pyrite at all firing temperatures

PCE: <28
Overburden: 10'-20'; sediment above: coal, 3½'-4½'; sediment below: sandstone.
Bonding properties: 7.10 (GCS psi); 1.6% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, drain tiles, flower pots.

Sample 1491
NW¼ NW¼ SE¼ sec. 21, T. 33 N., R. 2 E.

Glacial drift, soil	5'	Thickness of clays	18'
Shale	12'	Extrusion properties	Good
No. 2 Coal	3'	Water of plasticity	13.0%
Underclay, dark (sample 1491-A)	10"	% Linear drying shrinkage	4.5
Underclay, light (sample 1491-B)	2' 1"		
Green clay-like band	6"-10"		
Underclay (sample 1491-D)	15'		
Limestone nodules			

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.0	4.0
Total linear shrinkage	7.0	8.5	8.5
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Pock-marked and spotted by pyrite at 2200°F

PCE: <28
Overburden: 20'; sediment above: coal, 3'; sediment below: calcareous (?).
Bonding properties: - (GCS psi); - (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, drain tile, flower pots.
Comment: Sample 1491 is a composite of samples 1491-A, 1491-B, and 1491-D.

Sample 1491-A

Thickness of clay	10"
Extrusion properties	Good
Water of plasticity	12.0%
% Linear drying shrinkage	5.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.0	3.5
Total linear shrinkage	7.5	9.0	8.5
Fired color	Cream	Cream	Gray

Surface texture of fired test bar: Spotted and pock-marked by pyrite at all firing temperatures

PCE: <28
Overburden: 20'
Bonding properties: 7.05 (GCS psi); 1.9% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, drain tile, flower pots.
Comment: Sample from top 10" of underclay below coal.

Sample 1491-B

Thickness of clay	2'1"
Extrusion properties	Good
Water of plasticity	12.0%
% Linear drying shrinkage	5.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	3.5	3.5
Total linear shrinkage	7.5	8.5	8.5
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 20'10"
Bonding properties: 7.00 (GCS psi); 2.0% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.
Comment: Sample from bottom 25" of underclay below coal.

Sample 1491-D

Thickness of clay	15'
Extrusion properties	Good
Water of plasticity	9.5%
% Linear drying shrinkage	4.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	4.5	4.5
Total linear shrinkage	6.0	8.5	8.5
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: <20'
Bonding properties: 6.00 (GCS psi); 1.6% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.
Comment: 15' of underclay below green, clay-like band.

Sample 1492
$SW\frac{1}{4}$ $NE\frac{1}{4}$ $SW\frac{1}{4}$ sec. 21, T. 33 N., R. 2 E.

Glacial drift, soil	10' - 20'	Thickness of clays	11'4"+
No. 2 Coal	$2\frac{1}{2}$'	Extrusion properties	Good
Underclay (sample 1492-A)	3'4"	Water of plasticity	17.0%
Green,clay-like band	10"	% Linear drying shrinkage	5.5
Underclay (sample 1492-B) (Base covered)	8'+		

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	3.0	5.0	6.0
Total linear shrinkage	8.5	10.5	11.5
Fired color	Salmon	Tan	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 10' - 20'; sediment above: coal, $2\frac{1}{2}$'; sediment below: ?
Bonding properties: - (GCS psi); - (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, pottery.
Comment : Sample 1492 is a composite of samples 1492-A and 1492-B.

Sample 1492-A

Thickness of clay	3'4"
Extrusion properties	Good
Water of plasticity	13.0%
% Linear drying shrinkage	7.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	1.0	3.0	4.5
Total linear shrinkage	8.5	10.5	12.0
Fired color	Pink	Salmon	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 10' - 20'
Bonding properties: 8.90 (GCS psi); 2.1% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, pottery.
Comment: 40" of underclay below coal.

Sample 1492-B

Thickness of clay	8'+
Extrusion properties	Good
Water of plasticity	13.0%
% Linear drying shrinkage	5.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	4.0	5.0
Total linear shrinkage	7.5	9.5	10.5
Fired color	Cream	Buff	Gray-buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 10' - 20'
Bonding properties: 7.93 (GCS psi); 1.8% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, pottery, stoneware, drain tile, flower pots.
Comment: 8' of underclay below green, clay-like band.

Sample 1493
NE¼ NE¼ SE¼ sec. 21, T. 33 N., R. 2 E.

Glacial drift, soil	15'+	Thickness of clay	6'
No. 2 Coal	2'	Extrusion properties	Fair
Underclay (sample 1493)	6'	Water of plasticity	19.0%
Sandstone		% Linear drying shrinkage	5.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	3.0	6.5	4.5
Total linear shrinkage	8.0	11.5	9.5
Fired color	Pink	Pink	Tan

Surface texture of fired test bar: Shows irregular edges

PCE: 28
Overburden: 17'; sediment above: coal, 2'; sediment below: sandstone.
Bonding properties: 9.30 (GCS psi); 3.4% (Optimum H_2O).
Possible uses: Refractories, bonding clay, structural clay products, drain tile, flue liners, flower pots.

Sample 1494
NW¼ NE¼ SW¼ sec. 22, T. 33 N., R. 2 E.

Glacial drift, soil	10'-15'	Thickness of clay	6'(?)
Covered	5'±	Extrusion properties	Good
Underclay (sample 1494)	6'(?)	Water of plasticity	18.0%
Sandstone		% Linear drying shrinkage	6.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.5	4.5
Total linear shrinkage	8.5	10.5	10.5
Fired color	Orange	Tan	Brown

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 15' - 20'; sediment above: coal (stripped); sediment below: sandstone.
Bonding properties: 8.05 (GCS psi); 2.5% (Optimum H_2O).
Possible uses: Bonding clay, stoneware, structural clay products, pottery, drain tile, flower pots.

Sample 1495
NE¼ SW¼ SE¼ sec. 22, T. 33 N., R. 2 E.

Glacial drift, soil	30'-35'	Thickness of clay	5'
No. 2 Coal	1'	Extrusion properties	Good
Underclay (sample 1495)	5'	Water of plasticity	16.0%
Sandstone		% Linear drying shrinkage	5.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	1.5	3.5	4.0
Total linear shrinkage	7.0	9.0	9.5
Fired color	Salmon	Salmon	Brown

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 30'-35'; sediment above: coal, 1'; sediment below: sandstone.
Bonding properties: 6.00 (GCS psi); 1.7% (Optimum H_2O).
Possible uses: Stoneware, structural clay products, pottery, drain tile.

Sample 1496-A
SE¼ NE¼ NE¼ sec. 27, T. 33 N., R. 2 E.

Glacial drift, soil	20'+	Thickness of clay	2'
No. 2 Coal	3'	Extrusion properties	Good
Underclay (sample 1496-A)	2'	Water of plasticity	16.5%
Green,clay-like band	10"	% Linear drying shrinkage	6.0
Underclay, sandy (sample 1496-C) (Base covered)	4'+		

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	3.5	5.0
Total linear shrinkage	8.0	9.5	11.0
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 23'; sediment above: coal, 3'.
Bonding properties: 8.08 (GCS psi); 1.5% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.
Comment: 2' of underclay above green, clay-like band.

Sample 1496-C

Thickness of clay	4'+
Extrusion properties	Good
Water of plasticity	17.0%
% Linear drying shrinkage	5.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	3.5	5.0
Total linear shrinkage	7.5	9.0	10.5
Fired color	Salmon	Salmon	Buff

Surface texture of fired test bar: Normal.

PCE: <28
Overburden: 25' 10"
Bonding properties: 7.50 (GCS psi); 2.0% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.
Comments: 4' of underclay below green, clay-like band.

Sample 1497
$NE\frac{1}{4}$ $NW\frac{1}{4}$ $NE\frac{1}{4}$ sec. 26, T. 33 N., R. 2 E.

Glacial drift, soil	5'-10'	Thickness of clay	9'
No. 2 Coal	Thin (?)	Extrusion properties	Fair
Underclay, sandy (sample 1497)	9'	Water of plasticity	14.0%
Sandstone		% Linear drying shrinkage	3.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	4.0	6.5
Total linear shrinkage	5.0	7.0	9.5
Fired color	Pink	Pink	Buff

Surface texture of fired test bar: Shows irregular edges.

PCE: 31 - 32
Overburden: 5' - 10'; sediment above: coal (thin); sediment below: sandstone.
Bonding properties: 6.90 (GCS psi); 2.0% (Optimum H_2O).
Possible uses: High heat duty refractories, structural clay products, stoneware, pottery, flue liners, drain tile, flower pots.
Comment: Possibly a cavity filling.

Sample 1498
NE¼ SW¼ NW¼ sec. 25, T. 33 N., R. 2 E.

Glacial drift, soil	20'	Thickness of clay	6'-8'
No. 2 Coal	stripped	Extrusion properties	Good
Underclay (sample 1498)	6'-8'	% Linear drying shrinkage	4.0
Sandstone			

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	1.0	2.5	4.5
Total linear shrinkage	5.0	6.5	8.5
Fired color	Pink	Pink	Buff

Surface texture of fired test bar: Normal

PCE: 28 - 29
Overburden: 20'; sediment above: coal mined out; sediment below: sandstone
Bonding properties: 5.70 (GCS psi): 0.8% (Optimum H_2O).
Possible uses: Medium heat duty refractories, structural clay products, flue liners, pottery, drain tile, flower pots.

Sample 1499-A
SE¼ NW¼ SE¼ sec. 25, T. 33 N., R. 2 E.

Glacial drift, soil	5'-20'+	Thickness of clay	4'
No. 2 Coal	2½'	Extrusion properties	Good
Underclay (sample 1499-A)	4'	Water of plasticity	14.0%
Green, clay-like band	8"	% Linear drying shrinkage	4.0
Underclay	?		
(Seen at water level)			

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	3.5	4.5	4.5
Total linear shrinkage	7.5	8.5	8.5
Fired color	Cream	Cream	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 5'-20'+; sediment above: coal, 2½'; sediment below: sandstone.
Bonding properties: 7.90 (GCS psi); 1.8% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, pottery, drain tile, flower pots.
Comment: 4' of underclay above green, clay-like band.

Sample 1500
NW¼ SE¼ NE¼ sec. 30, T. 33 N., R. 3 E.

Glacial drift, soil	60'-70'	Thickness of clay	5'-6'
No. 2 Coal	mined out	Extrusion properties	Fair
Underclay (sample 1500)	5'-6'	Water of plasticity	12.5%
Sandstone		% Linear drying shrinkage	2.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.5	8.5
Total linear shrinkage	4.5	6.5	10.5
Fired color	Cream	Cream	Cream

Surface texture of fired test bar: Shows irregular edges

PCE: 28 - 29
Overburden: 60' - 70'; sediment above: coal mined out; sediment below: sandstone.
Bonding properties: 7.60 (GCS psi); 1.6% (Optimum H_2O).
Possible uses: Medium heat duty refractories, bonding clay, structural clay products, flue liners, drain tile.

Sample 1502
NE¼ SW¼ NW¼ sec. 30, T. 33 N., R. 3 E.

Glacial drift, soil	20'-30'	Thickness of clay	5'
No. 2 Coal	2'	Extrusion properties	Fair
Underclay (sample 1502)	5'	Water of plasticity	15.0%
Sandstone		% Linear drying shrinkage	3.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	3.0	4.5	8.5
Total linear shrinkage	6.0	7.5	11.5
Fired color	Pink	Pink	Tan

Surface texture of fired test bar: Shows irregular edges

PCE: 31
Overburden: 20' - 30'; sediment above: coal, 2'; sediment below: sandstone.
Bonding properties: 8.30 (GCS psi); 2.0% (Optimum H_2O).
Possible uses: High heat duty refractories, bonding clay, structural clay products, flue liners, drain tile, flower pots.

Sample 1503
C S½ NE¼ sec. 29, T. 33 N., R. 3 E.

Glacial drift, soil	80' - 100'	Thickness of clay	7'
No. 2 Coal (?)	covered	Extrusion properties	Fair
Underclay (sample 1503)	7'	Water of plasticity	13.0%
Sandstone		% Linear drying shrinkage	3.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	1.0	3.0	5.5
Total linear shrinkage	4.0	6.0	8.5
Fired color	Pink	Pink	Cream

Surface texture of fired test bar: Shows irregular edges

PCE: 29
Overburden: 80' - 100'; sediment above: coal (?); sediment below: sandstone.
Bonding properties: 7.70 (GCS psi); 4.3% (Optimum H_2O).
Possible uses: Medium heat duty refractories, bonding clay, structural clay products, flue liners, drain tile, flower pots.

Sample 1504
SE¼ NE¼ SE¼ sec. 21, T. 33 N., R. 3 E.

Glacial drift, soil	80'-100'	Thickness of clay	2'+
No. 2 Coal (mined out)		Extrusion properties	Good
Underclay (sample 1504)	2' exposed	Water of plasticity	15.5%
(Base covered)		% Linear drying shrinkage	5.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	5.5	not fired
Total linear shrinkage	8.0	11.0	-
Fired color	Brick red	Brick red	-

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 80'-100'; sediment above: coal mined out; sediment below: limestone (?)
Bonding properties: 4.35 (GCS psi); 1.4% (Optimum H_2O).
Possible uses: Structural clay products, drain tile, flower pots.

Sample 1505
SW¼ NW¼ NW¼ sec. 28, T. 33 N., R. 3 E.

Glacial drift, soil	60'-65'	Thickness of clay	5'±
No. 2 Coal	2½'	Extrusion properties	Good
Underclay (sample 1505)	5'±	Water of plasticity	14.0%
		% Linear drying shrinkage	4.5

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.5	4.5	5.0
Total linear shrinkage	7.0	9.0	9.5
Fired color	Light salmon	Salmon	Buff

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 60'-65'; sediment above: coal, 2½'; sediment below: ?
Bonding properties: 7.56 (GCS psi); 1.5% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, stoneware, drain tile, flower pots.

Sample 1506
C W½ NW¼ sec. 22, T. 33 N., R. 3 E.

Glacial drift, soil	40'-50'	Thickness of clay	7'-8'
No. 2 Coal	2'+	Extrusion properties	Fair
Underclay (sample 1506)	7'-8'	Water of plasticity	14.0%
Sandstone		% Linear drying shrinkage	3.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	2.0	4.0	6.5
Total linear shrinkage	5.0	7.0	9.5
Fired color	Pink	Pink	Cream

Surface texture of fired test bar: Shows irregular edges.

PCE: 30
Overburden: 40'-50'; sediment above: coal, 2' (mostly mined out); sediment below: sandstone.
Bonding properties: 6.90 (GCS psi); 2.2% (Optimum H_2O).
Possible uses: Medium heat duty refractories, structural clay products, flue liners, drain tile, flower pots.

Sample 1507
SE¼ NW¼ NW¼ sec. 6, T. 34 N., R. 5 E.

Glacial drift, soil	50' - 60'	Thickness of clay	1' - 1½'
Shale	2'	Extrusion properties	Poor
No. 2 Coal	0" - ¼"	Water of plasticity	11.5%
Underclay (sample 1507)	1' - 1½'	% Linear drying shrinkage	3.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	+0.5	0.0	0.5
Total linear shrinkage	2.5	3.0	3.5
Fired color	Pink	Pink	Tan

Surface texture of fired test bar: Rounded edges and crumbly

PCE: <28
Overburden: 50' - 60'; sediment above: coal, 0 - ¼"; sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: Natural molding sand.

Sample 1508
SW¼ SE¼ NE¼ sec. 1, T. 34 N., R. 4 E.

Glacial drift, soil	40' - 45'	Thickness of clay	8" - 10"
Coal	2"	Extrusion properties	Good
Underclay (sample 1508)	8" - 10"	Water of plasticity	20.0%
Coal	½"	% Linear drying shrinkage	6.0
Underclay, very sandy	1' - 2'		

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	5.0	2.5	not fired
Total linear shrinkage	11.0	8.5	-
Fired color	Brick red	Brick red	-

Surface texture of fired test bar: Normal

PCE: <28
Overburden: 40' - 45'; sediment above: coal, 2"; sediment below: coal ½".
Bonding properties: 8.90 (GCS psi); 2.1% (Optimum H_2O).
Possible uses: Bonding clay, structural clay products, drain tile.

Sample 1509
NW¼ NW¼ SW¼ sec. 13, T. 33 N., R. 2 E.

Glacial drift, soil	20'-25'	Thickness of clay	1½'-2'
No. 2 Coal	2'+	Extrusion properties	Would not extrude, too sandy
Underclay, sandy, coal streaks (sample 1509)	1½'-2'	Water of plasticity	-
Sandstone		% Linear drying shrinkage	-

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	-	-	-
Total linear shrinkage	-	-	-
Fired color	-	-	-

Surface texture of fired test bar: No test bar

PCE: <28
Overburden: 20'-25'; sediment above: coal, 2'+; sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: Natural molding sand.

Sample 1510
W½NW¼ SE¼ sec. 13, T. 33 N., R. 2 E.

Glacial drift, soil	20' stripped	Thickness of clay	1'2"
No. 2 Coal		Extrusion properties	Too sandy to hold sharp edges
Underclay, purple, sandy (sample 1510)	1'2"	Water of plasticity	8.0%
Sandstone		% Linear drying shrinkage	2.0

Firing temperature	1832°G	2012°F	2200°F
% Linear firing shrinkage	+1.0	+1.0	0.0
Total linear shrinkage	1.0	1.0	2.0
Fired color	Tan	Tan	Buff

Surface texture of fired test bar: Rounded edges and crumbly

PCE: 28-29
Overburden: 20'; sediment above: coal (stripped); sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: Medium heat duty refractories (?), natural molding sand.

Sample 1511

NW¼ NW¼ SE¼ sec. 18, T. 33 N., R. 3 E.

Glacial drift, soil	10'	Thickness of clay	2½'
No. 2 Coal	2½'	Extrusion properties	Too sandy to hold sharp edges
Underclay, sandy (sample 1511)	2½'	Water of plasticity	9.0%
		% Linear drying shrinkage	1.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	0.0	1.0	1.0
Total linear shrinkage	1.0	2.0	2.0
Fired color	Brick red	Brick red	Brick red

Surface texture of fired test bar: Rounded edges and crumbly

PCE: <28
Overburden: 10'; sediment above: coal, 2½'; sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: Natural molding sand.

Sample 1512

NE¼ NE¼ NE¼ sec. 17, T. 33 N., R. 3 E.

Glacial drift, soil	20'-25'	Thickness of clay	6'
No. 2 Coal	stripped	Extrusion properties	Fair
Underclay (sample 1512)	6'	Water of plasticity	11.0%
Sandstone		% Linear drying shrinkage	2.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	0.0	2.0	3.5
Total linear shrinkage	2.0	4.0	5.5
Fired color	Gray	Gray	Gray

Surface texture of fired test bar: Shows irregular edges

PCE: 28-29
Overburden: 20'-25'; sediment above: coal (stripped); sediment below: sandstone.
Bonding properties: 3.50 (GCS psi); 1.3% (Optimum H_2O).
Possible uses: Medium heat duty refractories, structural clay products, flue liners, drain tile, flower pots.

Sample 1513
SW¼ SW¼ SE¼ sec. 18, T. 33 N., R. 3 E.

Glacial drift, soil	10' - 15'	Thickness of clay	1½' - 6'
No. 2 Coal	2½'	Extrusion properties	Too sandy to hold sharp edges
Underclay (sample 1513)	1½' - 6'		
Sandstone		Water of plasticity	10.0%
		% Linear drying shrinkage	2.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	0.0	1.0	2.0
Total linear shrinkage	2.0	3.0	4.0
Fired color	Pink	Cream	Cream

Surface texture of fired test bar: Rounded edges and crumbly

PCE: 31 - 32
Overburden: 10' - 15'; sediment above: coal, 2½'; sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: High heat duty refractories (?); natural molding sand.

Sample 1514
SE¼ NW¼ SW¼ sec. 9, T. 33 N., R. 3 E.

Glacial drift, soil	20' - 30'	Thickness of clay	5'
No. 2 Coal	2'	Extrusion properties	Too sandy to hold sharp edges
Underclay, sandy (sample 1514)	5'		
Sandstone		Water of plasticity	8.5%
		% Linear drying shrinkage	2.0

Firing temperature	1832°F	2012°F	2200°F
% Linear firing shrinkage	+1.0	0.0	0.0
Total linear shrinkage	1.0	2.0	2.0
Fired color	Tan	Tan	Tan

Surface texture of fired test bar: Rounded edges and crumbly

PCE: <28
Overburden: 20' - 30'; sediment above: coal, 2'; sediment below: sandstone.
Bonding properties: too sandy (GCS psi); - (Optimum H_2O).
Possible uses: Natural molding sand.

RECOMMENDATIONS

The clay deposits thin north and northeast of the Illinois River. As shown in figure 1, the beds on the west side of the LaSalle Anticline dip more steeply than do the beds on the east side. The gentle dip east of the anticline makes the east slope a more favorable area for exploitation of the clay deposits.

The north-south canyons of Starved Rock State Park cut through the clay and underlying rock along the Illinois River between Ottawa and LaSalle, exposing the clay along the tops of most of the canyons. Along the southern boundary of the park the best exposures with the thinnest overburden lie along the small streams.

Listed below are a few points to keep in mind when looking for these clay deposits in LaSalle County.

1) The clay commonly is found where Pennsylvanian and Ordovician rocks are in contact.

2) The clay thins rapidly north of the Illinois River and has been entirely eroded in many parts of this area.

3) West of the LaSalle Anticline, the rocks dip steeply westward, making it impossible to strip the clay except along the narrow, spotty outcrop belt close to the axis of the anticline near the Vermilion River. (The depth to the clay at the Matthiessen and Hegeler Zinc Company, marked on figure 3, is about 500 feet.)

4) East of LaSalle and along the south side of the Illinois River, the clay is found along the top of the river bluff, but its gentle eastward dip brings it to river level at Ottawa. East of Ottawa it is found only in subsurface, and on the river's south side the overburden becomes so thick that stripping is difficult. Along the north side of the river in the valley flat, between Ottawa and Marseilles, the overburden is 20 to 40 feet thick.

5) South of the Illinois River, between LaSalle and Ottawa, and especially along the south edge of the Starved Rock State Park, the clay deposits are fairly shallow and generally are at least 5 to 7 feet thick, although in a few places the clay is as much as 15 feet thick. South of this area the clay is covered by thicker overburden.

6) Figure 1 shows a large area of contact between the Pennsylvanian and Ordovician rocks cutting across the LaSalle Anticline and Vermilion River south of the Illinois River. The depth to the clay in this area is approximately 250 feet. This east-west linear depression corresponds to the valley of an ancient river that flowed to the west and cut a valley in the rocks as it crossed the LaSalle Anticline.

7) In outcrops from which samples 1491, 1492, 1496, and 1499 were taken, a narrow, green, clay-like band separated the gray underclay into an upper and lower portion. The band also was found in an old abandoned pit at Ottawa where it was 2 inches to 3 inches thick. West of Ottawa it was not found on the north side of the Illinois River. When fired, this green, clay-like band bloats and burns a deep brown color; it is not refractory. This clay should not be mixed with the clay above or below during the mining process. It probably occurs in most of the area south of the Illinois River and also east of Ottawa.

8) Because the clay in most of this county was deposited on an uneven surface, there may be a great variation in the thickness of the clay within a given area.

For any operation involving a new clay deposit from this region, it is recommended that drill samples of the clay be obtained first because, as mentioned above, weathered clay outcrop samples can give misleading results as to the fired color and texture of the material. The bonding strength may be greater for a weathered sample than for the same clay in its unweathered state.

The dashed line in figure 3 bounds an area in which the clay should have 100 feet of overburden or less. This is the area recommended for exploration by drilling. The subsurface data are sketchy throughout this region, yet the indications are that, if the clay is present, this should be the most favorable area for prospecting. Much of the shallow clay in this vicinity has already been or is now being mined and, although there are still a few of these areas along the south boundary of Starved Rock State Park, it is fairly evident that these deposits are limited. Thus, it is probable that in the future the deeper clay deposits may take on greater economic importance.

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